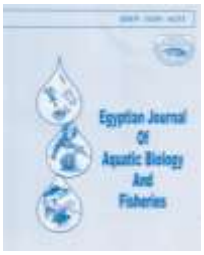
Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 22(5): 461 - 471 (2018)
www.ejabf.journals.ekb.eg



Length-weight relationship, condition factor and reproductive biology of the Thin-lipped grey mullet, *Liza ramada* (Risso, 1826) in Bardawil Lagoon, North Sinai, Egypt.

Attia A. O. El- Aiatt and Kariman A. Sh. Shalloof
Fisheries Biology Laboratory, National Institute of Oceanography and Fisheries, Egypt
Correspondence Author: dr_kariman88@yahoo.com

ARTICLE INFO

Article History:
Received: Nov. 28, 2018
Accepted: Dec.30, 2018
Online: Jan.2019

Keywords:
Bardawil Lagoon
North Sinai
Liza ramada
Reproductive biology
condition factor
Fecundity.

ABSTRACT

This paper concentrates on the reproductive biology of the Thin-lipped grey mullet, *Liza ramada*. 1567 individuals were obtained monthly from the different landing sites of the Bardawil lagoon, North Sinai, Egypt during the fishing season from May to December, 2017. The length-weight relation was found as 0.0063 $L^{3.0727}$, 0.0087 $L^{2.98}$ and 0.0095 $L^{2.9505}$ for males , females and combined sexes respectivly. Monthly condition factor values were generally low in September, and the highest values were recorded in October-December. The reproduction period (expressed by Gonado Somatic Index GSI) was determined to be in November and December.Overall ratio of males to females (M: F) was 1: 1.28. The recorded lengths at first maturity (L_m) was determined as L_m = 27.6 and 28.9 cm for males and females respectively . The absolute fecundity increased with total length and described by the power equation $F= 27.958\ L^{3.0135}$ (R^2 = 0.9458). The relative fecundity gradually increased from 11661.8 to 36098.3 eggs per cm. To protect *Liza ramada* in Bardawil Lagoon from exploitation, it is recommonded to ban the use of gears of illegal mesh sizes and other destructive fishing methods to permit the females to breed , grow, and recruit into the fisheries ground. Length at first maturity(L_m) must be increased by widening the net mesh size to catch *L. ramada* of lengths greater than 29.0 cm.

INTRODUCTION

Bardawil lagoon is one of the largest salt water lagoons in the northern coast of Sinai province of Egypt. Seven species (grey mullet, thin lip grey mullet, sea bream, sea bass, common sole, Egyptian sole, and shrimp) are centered of the lagoon (Mehanna *et al*., 2011) .*Liza ramada* plays an economical-fisheries vital roles in Egypt, since it constitute more than 12.3 % of the total catch of Bardawil lagoon and about 35 % of Mugilidae catch (GAFRD, 2016). The thin lipped (*L. ramada*) are euryhaline and diadromous species that enter coastal lagoons during early life stages to fulfilled growth previous to sexual maturation (Papa *et al*., 2003). Family (Mugilidae) has a worldwide distribution in warm waters, where its members grow well on algae and detritus (Keith *et al*., 2000). Descriptions of reproductive strategies or the evaluation of fecundity are essential topics in the discipline of the biology and population dynamics of fish species. This will extend our Knowledge about a state of

a stock and improves standard assessments of many commercially precious fish species (Hunter *et al*., 1992 & Murua *et al*., 2003).

This paper presents reproduction biology of the thin-lipped mullet, *Liza ramada*, in Bardawil lagoon as a basic step to launch a modern fishery management strategy for this species.

MATERIALS AND METHODS

The study was carried out in the Bardawil lagoon. The lagoon is separated from the Mediterranean Sea by a sandy bar with two narrow inlets. It is considered as a natural depression with range in depth from 0.3 to 5 m. The surface water temperature varied between a minimum of 14.8^0C during January to a maximum of 29.4^0C in August, with annual mean of 22.7^0C (Mehanna, 2014) .The salinity ranged from 48.46 in March to 51.86 ppt in September (Khalil *et al*., 2016) .The fishing is seasonal, begins from April to the end of December, (El -Ganainy *et al*., 2002). Monthly random samples (1567 individuals) of Thin-lipped grey mullet, *Liza ramada* were collected from the different landing sites of the Bardawil lagoon, North Sinai. The sampling period were lasted during the fishing season from May to December, 2017. In the laboratory, total lengths to the nearest centimeter and total weight to the nearest 0.1 gram were recorded. The relationship between length and weight was calculated using the formula $W = a L^b$ where W is the total weight in grams, L is the total length in centimeters and a & b are constants whose values were estimated by the least square method.

The condition factor was computed monthly by the formula $Kc = (W * 100) / L^3$ (Hile, 1936), Where: Kc = condition factor, W = weight in gram, and L = length in centimeter. The sex, stage of maturity and fecundity of individual fish of 463 samples (Fig. 1) were recorded.

Fig. 1: Thin-lipped grey mullet, *Liza ramada*(A and B) in Bardawil lagoon.

The gonads after being removed were weighed to the nearest 0.01 g. The ovaries were removed and preserved in 10% formalin for further studies. Maturity stages were determined with naked eye and by microscope in young specimens. In order to determine the spawning season, Gonado-Somatic index GSI was estimated as: (Weight of gonad / Weight of fish) × 100 (Parameswarn *et al.*, 1974). Sex ratio was calculated monthly. The length and age at first maturity (L_{50}), where 50% of fish

reach their sexual maturity was estimated by fitting the maturation curve between the percentage maturities of fish corresponding to each length class interval.

The absolute fecundity ($F_{abs.}$) is defined as the number of mature eggs in the ovaries during the spawning season. 44 mature ovaries of adult females were used for length range from 21.2 to 36.7cm total length. The gonads were removed, weighed to the nearest 0.001gm and placed in glass bottle with 10% formalin. Later, gonads washed and dried. Subsamples were taken from different parts of the ovaries. The ovarian tissue was removed and weighed to obtain the net eggs weight. The subsamples weighted (1gm), and eggs were well mixed, and placed on slide which was divided into squares. The eggs of twenty squares under the microscope were counted, and the total number of eggs in the subsample was counted. Then, the total fecundity was calculated as:

F= [(Gonad Weight * Egg Number in the Subsample (1 gm.)] (Yeldan and Avsar, 2000). The relative fecundity (F_{rel}) was calculated as: $F_{rel} = F_{abs}$ / (Body Length or Body weight). The relationship between the total length (L_t) and fecundity using the least squares method was recorded.

RESULTS

A total of 1567 samples thin-lipped grey mullet, *Liza ramada* from the Bardwil lagoon were collected from May to December, 2017, ranged from 13 to 36.7 cm, and the observed total weight from 22.3 to 441 g. The length – weight relationship was described by the power equation as: $W= 0.0063\ L^{3.0727}$ ($R^2 = 0.9602$), $W= 0.0087\ L^{2.98}$ ($R^2 = 0.9537$) and $W= 0.0095\ L^{2.9505}$ ($R^2 = 0.9455$) for males, females and combined sexes respectively (Figs.2, 3 and 4).

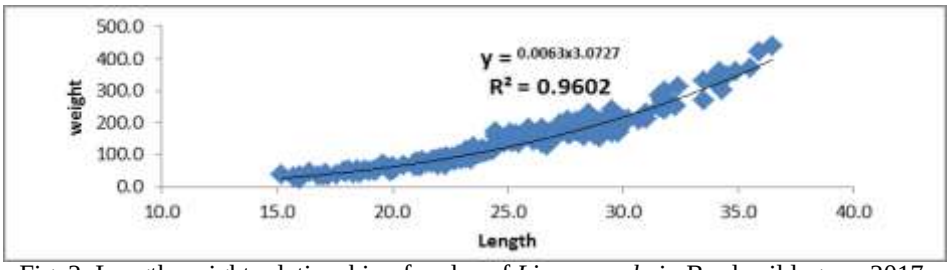


Fig. 2: Length weight relationship of males of *Liza ramada* in Bardawil lagoon 2017.

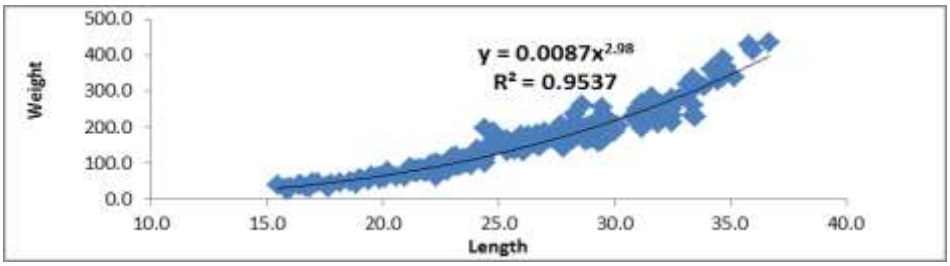


Fig. 3: Length weight relationship of females of *Liza ramada* in Bardawil lagoon 2017.

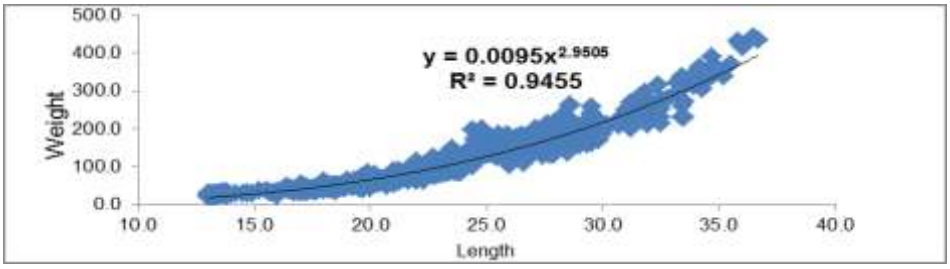


Fig. 4: Length weight relationship of combined sexes of *Liza ramada* in Bardawil lagoon 2017.

Monthly mean condition factor for female, male and combined sexes were nearly similar for both sexes and were generally low in September, and the highest values were recorded in October-December (Fig. 5). A decline in (K) was observed during November in female accompanied by a slight increase in males in the same month.

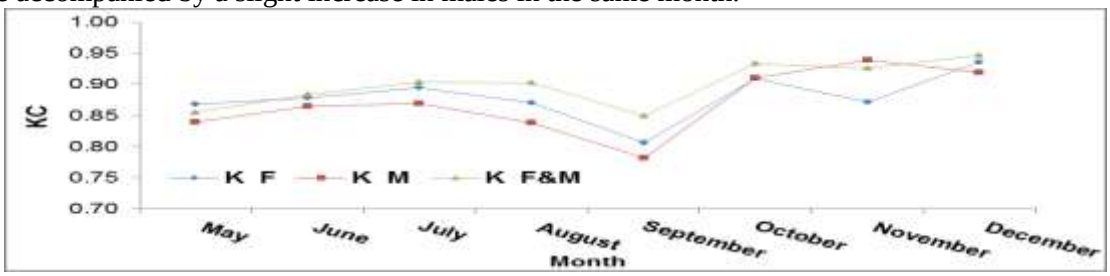


Fig 5: Monthly variation in condition factor (K) of combined sexes (F&M), females (F) and males (M) of *L. ramada* during 2017.

Sex ratio:

It was seen from sex distribution in Table (1) that the two sexes did not distributed in the same proportion during different months. Females predominated during all months except in December, since it constitute more than 50 % of the collected sample during the period of study.Overall ratio of males to females (M: F) was 1: 1.28. This means that the existed number of females was relatively higher than males.

Table 1: Monthly variations in sex ratio of *Liza ramada* from Bardawil lagoon during the fishing season 2017.

		Males		Females		sex ratio
Month	No. of fish	NO	%	NO	%	M/F
May	52	24	46.2	28	53.8	1 - 1.17
June	35	16	45.7	19	54.3	1 - 1.19
July	45	19	42.2	26	57.8	1 - 1.37
August	51	22	43.1	29	56.9	1 - 1.32
September	50	21	42.0	29	58.0	1 - 1.38
October	69	26	37.7	43	62.3	1 - 1.65
November	94	41	43.6	53	56.4	1 - 1.29
December	67	34	50.7	33	49.3	1 - 0.97
	463	203	43.8	260	56.2	1 - 1.28

Gonado- Somatic Index (GSI):

Gonad development was followed using the GSI. The reproduction period (expressed by GSI) of *Liza ramada* was determined to be in November and December, since GSI peaked in these two monthes (7.01 and 6.96 % respectively). *L. ramada* has a long spawning season, extends from August to December. GSI of the males was lower than that of females. GSI of the females increased rapidly from August to December. The lowest values of Gonado Somatic Index (GSI) was recorded in May (0.38), (Fig.6).

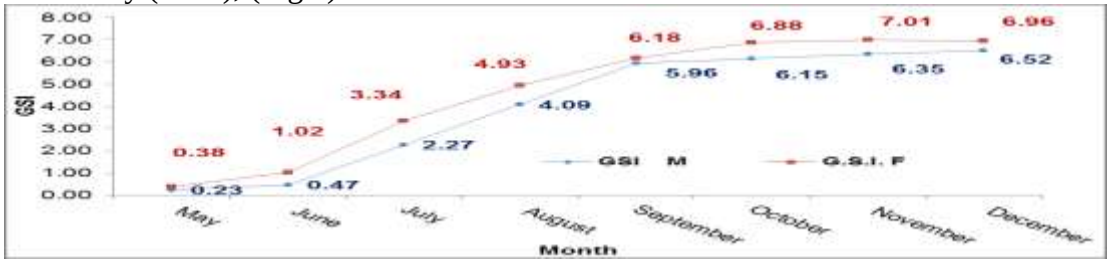


Fig. 6: Changes in Gonado Somatic Index (GSI) of *Liza ramada* in Bardawil lagoon during 2017.

The immature and mature fish for each length group was analyzed to determine the length at first maturity (L_m) (Table 2). All males and females are mature at a total length higher than 25 and 26 cm respectively. The length at first maturity (L_m) was determined as 27.6 and 28.9 cm for males and females respectively (Fig. 7).

Table 2: The percentage of mature and immature fishes of different length groups of *Liza ramada* from Bardawil lagoon during 2017.

L groups(cm)	Av.	Immature		Mature		Av.	Immature		Mature	
		No	%	No.	%		No.	%	No.	%
15-15.9	15.7	3	100.0		0.0	15.5	2	100		0.0
16-16.9	16.5	8	100.0		0.0	16.3	2	50.0	2	50.0
17-17.9	17.5	5	100.0		0.0	17.4	4	80.0	1	20.0
18-18.9	18.6	3	100.0		0.0	18.4	3	50	3	50.0
19-19.9	19.5	5	71.4	2	28.6	19.5	3	33.3	6	66.7
20-20.9	20.5	3	75.0	1	25.0	20.1	0	0.0	5	100
21-21.9	21.6	4	33.3	8	66.7	21.4	6	42.9	8	57.1
22-22.9	22.4	8	40.0	12	60.0	22.5	6	35.3	11	64.7
23-23.9	23.5	7	46.7	8	53.3	23.4	5	38.5	8	61.5
24-24.9	24.4	11	52.4	10	47.6	24.4	6	46.2	7	53.8
25-25.9	25.5	8	61.5	5	38.5	25.3	4	36.4	7	63.6
26-26.9	26.4	10	45.5	12	54.5	26.5		0.0	20	100
27-27.9	27.5		0.0	15	100	27.6		0.0	5	100
28-28.9	28.6		0.0	20	100	28.5		0.0	13	100
29-29.9	29.4		0.0	42	100	29.5		0.0	42	100
30-30.9	30.3		0.0	6	100	30.3		0.0	3	100
31-31.9	31.5		0.0	14	100	31.5		0.0	7	100
32-32.9	32.3		0.0	11	100	32.3		0.0	3	100
33-33.9	33.4		0.0	8	100	33.5		0.0	2	100
34-34.9	34.6		0.0	7	100	34.3		0.0	6	100
35-35.9	35.5		0.0	2	100	35.7		0.0	2	100
36-36.9	36.4		0.0	2	100	36.5		0.0	1	100
		75		185	71.2		41		162	

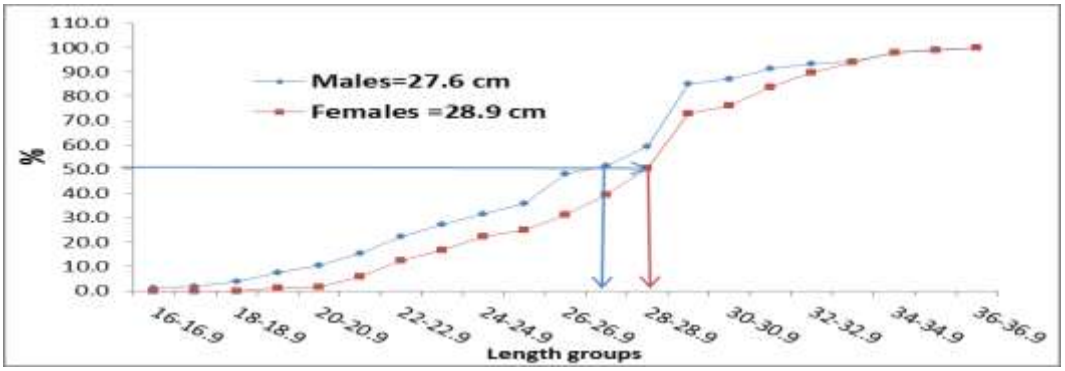


Fig. 7: Length at first maturity (L_m) of males and females of *Liza ramada* in Bardawil lagoon during 2017.

The relation between body size (total length and body weight) and fecundity (absolute and relative) of *L. ramada* were illustrated in Table (3). The number of eggs gradually increased by increasing fish length or weight, since fish of 21.2 cm (88.6 g.) lay about 247230 eggs, reaching maximum of about 1299540 eggs at fish length 36.7 cm, (433.9 gm.).

Table 3: Absolute fecundity of *Liza ramada* from Bardwil lagoon during 2017.

L group(cm)	No.	Av. L	Av. Abs. Fec.	Min.	Max.
21-22	2	21.4	273240.0	247230	299250
22-23	4	22.5	327865.0	303840	345100
23-24	2	23.6	369970.0	339040	400900
24-25	2	24.5	391800.0	369600	414000
25-26	3	25.4	444580.0	426240	468300
26-27	2	26.2	513000.0	511200	514800
27-28	4	27.5	564625.0	486200	614100
28-29	7	28.4	729675.7	707400	761600
29-30	7	29.4	816521.4	746200	858480
30-31	3	30.1	892290.0	852110	950040
31-32	5	31.4	901656.0	866700	979200
32-33	8	32.3	1051998.8	912600	1118000
33-34	6	33.4	1027793.3	798080	1177300
34-35	5	34.5	1128974.0	962560	1252080
35-36	2	35.5	1239850.0	1228500	1251200
36-37	2	36.4	1275720.0	1251900	1299540
	64				

The absolute fecundity was increased with a total length and described by power equation $F = a L^b$ since $F= 27.958 L^{3.0135}$, ($R^2 = 0.9458$). The relative fecundity gradually increased from 2851 to 5101 eggs per gm. The relative fecundity gradually increased from 11661.8 to 36098.3 eggs per cm .The relation between fecundity and size was illustrated in Figs. 8 and 9.

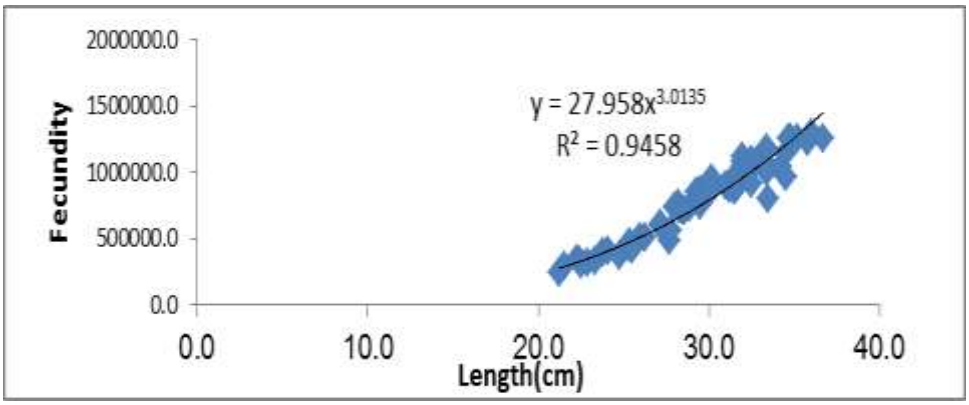


Fig. 8: Relationship between total length and Absolute fecundity of *L. ramada* collected from Bardawil lagoon, 2017.

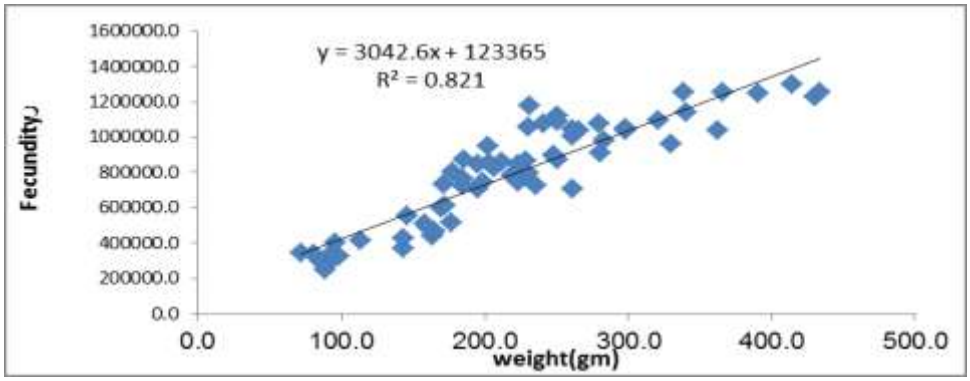


Fig. 9: Relationship between body weight (g) and Absolute fecundity of *L. ramada* collected from Bardawil lagoon, 2017.

DISCUSSION

Mullets are important economic resources that support many small groups through both fishing and aquaculture (Pina & Chaves 2005, Katselis *et al.* 2005). The Length-weight relationship is actual index of the condition of fish and alters over the year according to factors namely food availability, feeding rate, gonad development and spawning time (Bagenal and Tech, 1978). In the present study Length-weight relationship were $w= 0.0063\ L^{3.0727}$, $W=0.0087\ L^{2.98}$ and $W= 0.0095\ L^{2.9505}$ of males, females and combined sexes respectively. Table 4 compare length -weight relationships regression parameters (a and b) of *Liza ramada* from different locations.

Table 4: Comparison of length (cm)-weight (g) relationships regression parameters (a and b) of *Liza ramada* from different locations .

Author	Location	a	b
Mehanna(2006)	Bardwil lagoon	0.0052	3.13
Salem *et al*., (2010)	Bardwil lagoon	0.0177	2.7642
Kasimoglu *et al*.,(2011)	The Southern Aegean Sea, Turkey	0.0005	2.253
Mohamed (2016)	Bardwil lagoon	0.017	2.764
Present study (♂)	Bardwil lagoon	0.0063	3.0727
Present study (♀)	Bardwil lagoon	0.0087	2.98
Present study (combined sexes)	Bardwil lagoon	0.0095	2.9505

Our results are lower than that recorded by (Mehanna, 2006). On the other hand, these results were higher than that obtained by (Salem *et al*., 2010 and Mohamed 2016) in Bardaweel Lagoon and (Kasimoglu *et al*., 2011) in the Southern Aegean Sea, Turkey, Table 4. Difference in 'b' values can be due to the combination of several factors such as number of specimens studied, habitat, and status of stomach fullness, gonadal maturity, sex, health and overall fish condition, and differences in the observed length ranges of the specimens caught (Abowei *et al.*, 2009). In the present study, a decline was observed in the value of (K) during November in female and accompanied by slight increase in males. This may possibly due to some females begins to spawn in this month and consequently a decline in condition factors in female was occurred. Fish size and condition are key parameters to properly assess fecundity at the population level (Murua *et al.,* 2003)

The availability of data based on reproductive parameters and environmental variation leads to a finer knowledge of observed variation in reproductive output and magnifies our ability to assess recruitment (Kraus *et al*., 2002). *L. ramada* have a long spawning season extends from Augusts to December. GSI of *L. ramada* was recorded in different months to confirm the spawning period. These results agree with that reported by (Salem *et al.,* 2010 and Mohamed 2016) in Bardwell lagoon and with (El Halfway *et al.*, 2007). Salem and Mohammed (1982) in Lake Timsah found that the GSI values of Liza *ramada* were 2.2, 4.3 and 2.2, in October, November and December respectively. Sagi and Abraham *et al*. (1985) reported that *Liza ramada* has topmost GSI values during the period of migration to the Sea. Yerli (1991) found that the values of GSI were 18.96 and 16.17 at November and December respectively.

In the present study, sex ratio of *L. ramada* was about one male to 1.3 female (1.0:1.28) with percentage 43.8 % and 56.2 % for male and female respectively. This results agreed with (Kasimoglu *et al*. 2011) in the Southern Aegean Sea, Turkey, the sex ratio was one male to 1.26 female. Ergene (2000) in Akgöl-Paradeniz Lagoons (Göksü Delta) found that the sex ratio of *L. ramada* was 53.74% to 43.28% for females and males respectively. El-Halfway *et al*. (2007) recorded that the sex ratio of the collected sample 238 fish of *Liza ramada* in Lake Timsah was 1:1.7 male to

female. Abd Alhafid and El-Mor (2014) studied the monthly variations in sex ratio between females (159 fish = 63.6%) and males (91 fish =36.4%). Sex ratio was (1: 1.75) for males to females respectively during all months and showed that the numbers of the females was dominated over the males.

Length at first maturity (L_m) has a great importance in the determination of optimum mesh size (Mehanna, 2007). In the present study the length at first maturity (L_m) was determined as L_m = 27.6 and 28.9 cm for males and females respectively. Muss and Dahlström (1978) found that, the length at first sexual maturity of *L. ramada* as L_m=25.9cm, ranged between 25-32cm. El-Halfway *et al*. (2007) found that the smallest ripe male was 14 cm while the smallest ripe female was 16 cm, and L_m was at total length 18.6 and 19.8cm for male and female respectively. In the present study, all males larger than 22 cm and females larger than 24 cm are sexually mature. Kaya (2010) reported that, the reason for these differences is that the first spawning age and size is affected by environmental factors such as temperature, feed consumption (quantity and quality) and the water systems in which the fish live.

In the present study the absolute fecundity was increased with total length and described by power equation $F = a L^b$ as $F= 27.958 L^{3.0135}$ ($R^2 = 0.9458$) and the relative fecundity gradually increased from 11661.8 to 36098.3 eggs per cm. The absolute fecundity reported by other workers for *L. ramada*, (Farrugio and Quignard ,1973) in Tunis reported an absolute fecundity of 82 202 to 434 787 eggs and relative fecundity of 604 to 1454 eggs per 1 g for lengths ranging from 255 to 345 mm (SL). In Egypt, (El Maghraby *et al.*, 1974) reported 45 568 to 316 828 eggs absolute fecundity and 728 to 992 eggs per 1 g relative fecundity. Abdalhafid and El-Mor (2014) estimated the fecundity of *L. ramada* from Ain El-Ghazala lagoon (Libya) as 51231 to 236557 eggs in fishes ranged in length from 16.5 to 32.4cm. Albieri and Araújo (2010) mentioned that, high fecundity would be a tactic to enable success in *M. liza* recruitment to the Sepetiba bay in tropical Brazilian. Hickling (1970), in southern England, found only two ripening females of *L. ramada* with 581 000 and 1 243 000 eggs with lengths 490 to 530 mm, respectively. Ergene (2000) found 234 720 to 435 265 eggs for ages III and IV respectively. These differences can be attributed either to the high spatial variation of the studies, thus to different environmental conditions or to the methods used that produce variable results (e.g., counting or not the oocytes that will not mature), but mainly to the differences in length, weight or age in the samples of the different authors, since absolute fecundity increases as those parameters increase (Hotos *et al*. 2000).

CONCLUSION

It could be concluded that, *Liza ramada* in Bardawil Lagoon has a long spawning season extends from August to December, with a peak during November and December. Overall ratio of males to females (M: F) was 1: 1.28.The length at first mature (L_m) was determined as 27.6 and 28.9 cm for males and females respectively. It is recommonded to ban the use of gears of illegal mesh sizes and other destructive fishing methods, and increase mesh size used in Bardaweel Lagoon to catch *L. ramada* to lengths greater than 29.0 cm, to protect *L. ramada* from exploitation and permit the females to breed , grow, and recruit into the fisheries ground.

REFERENCES

Abdalhafid, Y. K and El-Mor, M. (2014). Some aspects of the reproductive biology of the thin lip grey mullet *Liza ramada* (Risso, 1826) in Ain El-Ghazala lagoon–eastern Libya. International journal of bioassays, 3 (04): 2041-2044.

Abowei, J. F. N.; Daviesand, O. A. and Eli, A. A. (2009). Study of the length –weight relationship and condition factor of five fish species from Nkoro River,Niger Delta, Nigeria. Curr. Res. J. Bio. Sci. 1(3): 94-98.

Albieri,R.J. and Araújo, F. G. (2010). Reproductive biology of the mullet *Mugil liza* (Teleostei: Mugilidae) in a tropical Brazilian bay ZOOLOGIA 27 (3): 331–340.

Bagenal, T. B. and Tesch, F. W. (1978). Age and growth In: T.Bagena, editor, methods for assessment of fish production in fresh waters . IBp handbook No.3 (3rded) Black well sci. publications, oxford. pp 101-136(chapter 5).

EL-Ganainy, A. A.; E. T Mostafa and Omran, M. A. (2002). Fisheries status of the stribed Mullet (pisces: Mugilidae) from Bardawil Lagoon. Egypt. J. Aquat. Biol. & Fish. 6: 47-65.

EL-Halfawy, M.; Ramadan, A. M. and Mahmoud W. F. (2007). Reproductive biology and histological studies of the grey mullet, *Liza ramada*, (RISSO, 1826) in Lake Timsah, Suez Canal. Egyptian J. Aquatic Res., 33 (1): 434-454.

El Maghraby, A.M.; Hashem, M.J. and El Sedfy, H.M. (1974). Sexual maturity, spawning migration and fecundity of M. capito in Lake Borullus. Bulletin of the Institute of Oceanography and Fisheries, ARE, 4: 35–56.

Ergene, S. (2000). Reproduction Characteristics of Thinlip Grey Mullet, *Liza ramada* (Risso, 1826) Inhabiting Akgöl-Paradeniz Lagoons (Göksü Delta), Turk J Zool, 24: 159–164.

Farrugio, H. and Quignard , J.P. (1973). Biologie de Mugil (Liza) ramada Risso, 1826 et de Mugil (Chelon) labrosus Risso, 1826 (Poissons, Teleosteens, Mugilides) du lac de Tunis. Taille de premiere maturite sexuelle, cycle et fecondite. Bulletin de l'Institut National Scientifique et Technique d'Oceanographie et de Peche de Salammbo 2 (4): 565–578.

GAFRD (2016). Report of General Authority for Fish Resources Development on Egyptian Fishery.

Hickling, C.F. (1970). A contribution to the natural history of the English grey mullet [Pisces, Mugilidae]. Journal of the Marine Biological Association of the United Kingdom 50 (3): 609–633. DOI: 10.1017/S0025315400004914.

Hile, R. (1936). Age and growth of the Cisco *Leucichthys arted* in the lakes of the north eastern high lands, Wisconsin. Bull. U. S. Bur. Fish., 48: 211-317.

Hotos, G.N., Avramidou D., Ondrias I. (2000). Reproduction biology of *Liza aurata* (Risso, 1810), (Pisces: Mugilidae) in the lagoon of Klisova (Messolonghi, W. Greece). Fisheries Research, 47 (1): 57–67.

Hunter, J.R.; Macewicz, B.J.; Lo, N.C.H. and Kimbrell, C.A. (1992). Fecundity, spawning and maturity of female Dover Sole, *Microstomus pacificus*, with an evaluation of assumptions and precision. Fisheries Bulletin of United States, 90: 101-128.

Kasimoğlu, C.; Yilmaz, F. and Koc, H. T. (2011). Growth and Reproductive characteristics of the Thin-lipped Grey Mullet, *Liza ramada* (Risso, 1826) Inhabiting in Gökova Bay (Muğla), the Southern Aegean Sea, Turkey. BAÜ Fen Bil. Enst. Dergisi Cilt, 13(2): 35-49.

Katselis G.; Koutsikopoulos, C.; Rogdakis, Y.; Lachanas, T.; Dimitriou, E. and Vidalis, K. (2005). A model to estimate the annual production of roes

(avgotaracho) of flathead mullet (*Mugil cephalus*) based on the spawning migration of species. Fishery Research, 75: 138-148

Kaya, N. (2010). A Study on Some Biological Properties of *Liza abu* (Heckel, 1846) Living in Devegeçidi Dam Lake (Diyarbakır). Masters thesis, Yüzüncü Yıl Üniversitesi, Fen Bilimleri Ens., Van, pp. 62. (In Turkish).

Keith, P.; Le Bail, P.Y. and Planquette, P. (2000).Atlas des poissons d'eau douce de Guyane (tome 2, fascicule I). Publications Scientifiques du Muséum National d'Histoire Naturelle, 286 p, Paris.

Khalil, M. T.; Saad, A. A.; Ahmed, M.H.M.; El Kafrawy, S. B. and Emam, W.W.M. (2016). Integrated Field Study, Remote Sensing and GIS Approach for Assessing and Monitoring Some Chemical Water Quality Parameters in Bardawil Lagoon, Egypt. Int. Inno.Res.Scie., Eng. & Techno. 5(8): 14656-14669.

Kraus, G.; Tomkiewicz, J. and Kõster, F.W. (2002). Egg production of Baltic cod in relation to variable sex ratio, maturity and fecundity. Candian J. Fish. Aquat. Sci., 59: 1908-1920.

Mehanna,. S. F. (2006).Fisheries management of the thinlip Grey mullet *Liza ramada* and golden grey mullet *Liza aurata* from lake Bardawil Egypt. J. Aquat. Biol. & Fish., 10(2): 33 -53.

Mehanna, S.F. (2007). Stock assessment and management of the Egyptian Sole *Solea aegyptiaca* Chabanaud, 1927 (Osteichthyes: Soleidae), in the Southeastern Mediterranean, Egypt. Turkish J. Zool., 31: 379-388.

Mehanna, S.F. (2014). Reproductive dynamics of the common sole Solea solea (Linnaeus, 1758) from Bardawil lagoon, North Sinai, Egypt. Tropentag 2014: Conference on International Research on Food Security, Natural Resource Management and Rural Development. Organized by the Czech University of Life Sciences Prague.

Mehanna, S.; A. El-Aiatt and Salem, M. (2011). An investigation of the impacts of shrimp bottom trawling on the Bardawil lagoon fisheries, Egypt.4th International conference on Fisheries and Aquaculture, 3-5 October, Cairo, Egypt. (Egyptian J. of Aquatic Biology and Fisheries., 15:(3): 407-416.

Mohamed,A.A.M.(2016).Biological and fisheries studies of the thin lip grey mullet *liza ramada* fish in Bardawil lagoon, Msc. Thes. Fac. Enviro. Agric. Scie. Suez Canal Univ.

Murua, H., G. Kraus, F. Saborido-Rey, P.R. Witthames, A. Thorsen and S. Junquera. (2003). Procedures to estimate fecundity of marine fish species in relation to their reproductive strategy J. Northwest Atlantic Fish. Sci., 33: 33-54.

Muus, B. and Dahlström, P. (1978). Meeresfische der Ostsee, der Nordsee, des Atlantiks. BLV Verlagsgesellschaft, München. 244 pp.

Papa, R., Marzano, F.N., Rossi, V., Gandolfi, G. (2003). Genetic diversity and adaptability of two species of Mugilidae (Teleostei: Perciformes) of the Po river delta coastal lagoons, Oceanologica Acta, 26: 121-128.

Parameswarn, S.; Sevaraj, C. and Radhakrishnan, S. (1974). Observation on the bilogy of *Labeo gonius* (Hamilton). Indian J. Fish., 21: 54-75.

Pina, J.V. and Chaves, P.T. (2005). A pesca de tainha e parati na Baía de Guaratuba, Paraná, Brasil. Acta Biológica Paranaense, 34: 103-113.

Sagi, G. and Abraham, M. (1985). Photoperiod and ovarian activity in the grey mullet L. *ramada* (Pisces. Mugilidae). Isra. J. Zool., 33. 1-9.

Salem, M.; EL Aiatt, A. A. and Ameran, M. (2010). Age, growth, mortality and yield per recruit of *Liza ramada* in Bardawill lagoon, North Sinai, Egypt. Abbassa Intern. J. Aqua. The third sci. Conf., Al Azhar Univ., Cairo, 17 –18 October) .

Salem, S. A. and Mohammed, S. Z. (1982).Studies on *Mugil seheli* and *Mugil capito* in Lake Timsa. I. Age and growth .Bull. Inst Oceanog. Fish. ARE, 8(1): 29-48.

Yeldan, H. and D. Avşar (2000). A preliminary study on the reproduction of rabbit fish, *Siganus rivulatus* (Forsskål, 1775), in the northeastern Mediterranean. Turk. J. Zool., 24: 173-182.

Yerli, S.V. (1991). Köyceğiz Lagűn Sistemindeki *L. ramada* (Risso. 1826) stoklari űzerine Yncelemeter. Doğa Tr. J. of Veterinary and Animal Sciences, 16: 103-120.

ARABIC SUMMARY

علاقة الطول بالوزن، معامل الحالة، بيولوجية التكاثر لأسماك الطوبارة في بحيرة البردويل شمال سيناء ، مصر

عطيه على عمر العياط ، و كريمان أحمد شوقى شلوف
معمل بيولوجيا المصايد - المعهد القومي لعلوم البحار والمصايد - مصر

تم إجراء هذا البحث بهدف تحديد بعض القياسات البيولوجية لتكاثر وخصوبة أسماك الطوبارة وهى سمكة اقتصاديه فى بحيرة البردويل . كانت قيمة الأس (ب) فى علاقة الطول والوزن ٣.٠٧٢٧ و٢.٩٨ و ٢.٨٥٠٥ في كلا من الذكور والاناث والجنسين معا على التوالى . تم فحص ٤٦٣ من الذكور والاناث من شهر مايو حتى ديسمبر عام ٢٠١٧ .ارتفع دليل المناسل تدريجيا وكانت القمة فى نوفمبر وديسمبر للذكور والاناث وكانت نسبة دليل المناسل ٧.٠١ و٦.٩٦% فى نوفمبر وديسمبر للإناث وكانت ٦.٢٣ و٦.٥٢ % للذكور واقل نسبة لدليل المناسل كانت فى شهر مايو ٠.٣٨ و ٠.٢٣% للإناث والذكور على الترتيب. وكان الطول عند النضج الجنسي ٢٧.٦ ، ٢٨.٩ سم للذكور والاناث على الترتيب . ارتفعت الخصوبة النسبية تدريجيًا من ٢٨٥١ إلى ٥١٠١ بيضة لكل جرام مع الزيادة في الوزن . ارتفعت الخصوبة مع الزيادة فى الطول ووصفت العلاقة بين الخصوبة المطلقة والطول بالمعادلة الخصوبة = ٢٧.٩٥٨ ل $^{٣.٠١٣٥}$.

نوصى بحظر استخدام الشباك غير القانونية وطرق الصيد المدمرة الأخرى وذلك للسماح للإناث بالتوالد والنمو فى مصيد بحيرة البردويل. كما يجب زيادة الطول عند النضج الأول (L_m) عن طريق توسيع سعة عين الشباك التى تستخدم لصيد الطوبارة وذلك عند طول أكبر من ٢٩.٠ سم.